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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of SINGHAL et al.

Serial No. 09/848,662 Examiner: Not Assigned

Filed: May 3, 2001 Group Art Unit: 2182

For: LOCATION-AWARE SERVICE PROXIES IN A SHORT-RANGE WIRELESS ENVIRONMENT

OIPE JC149 SEP 04 2001 PATENT & TRADEMARK OFFICE

CERTIFICATE UNDER 37 CFR 1.8(a)
I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First Class mail in an envelope addressed to the Asst. Commissioner of Patents, Washington, D.C., 20231 on Aug. 28, 2001

Glenn E. Gold Reg. No. 41,039

DATE: Aug. 28, 2001

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OFFICE OF PETITIONS

PETITION AND RESPONSE TO NOTICE OF OMITTED ITEMS IN A NONPROVISIONAL APPLICATION

Hon. Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

This communication is responsive to the Notice of Omitted Items in a Nonprovisional Application, mailed June 28, 2001, a copy of which is enclosed. This petition/response is accompanied by a $130.00 petition fee under 37 CFR 1.17(h).

REMARKS

Applicants concurrently filed two individual commonly-assigned patent applications on May 3, 2001, each having a corresponding set of informal drawing figures. Apparently, the applications for the two cases were advertently switched prior to filing, such that the first application was mailed along with filing papers (including drawings) corresponding to the second application and vice-versa.

Applicants contacted Customer Service (Preston Wallace) and were advised that

the respective files were being ordered and Applicants would be contacted as soon as the files were received in order to properly match the applications and corresponding filing papers.

Furthermore, Applicants contacted the Patent Assistance Center (Andrew James) and were advised to respond to the Notice by providing, along with this Petition/Response and the $130.00 petition fee, copies of the respective return postcards proving that the applications and associated filing papers were all filed on May 3, 2001. Copies of both postcards are enclosed. As further requested, applicants have provided herewith copies of both patent applications properly matched with the corresponding drawings and filing papers. If necessary, Applicants will file a request for corrected filing receipts after the applications, drawings and other filing papers are properly matched in the respective USPTO files.

Applicants submit that the above-noted "omitted" items were in fact deposited in the U.S. Patent and Trademark Office (USPTO) with the nonprovisional papers, and respectfully request that the enclosed petition fee be refunded.

Respectfully submitted,

Date: Aug 27, 2001

Glenn E. Gold
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Attorney Docket: 6020.0200

UNITED STATES PATENT AND TRADEMARK OFFICE

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OIPE
SEP 04 2001
JC149
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APPLICATION NUMBER	FILING/RECEIPT DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
09/848,662	05/03/2001	Sandeep K. Singhal	6020.0200

CONFIRMATION NO. 7321

FORMALITIES LETTER

OC000000006236094

GLENN GOLD, P.A.
Suite 450
600 North Pine Island Rd.
Plantation, FL 33324

Date Mailed: 06/28/2001

NOTICE OF OMITTED ITEM(S) IN A NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

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Technology Center 2100

A filing date has been accorded to the above-identified nonprovisional application papers; however, the following item(s) appear to have been omitted from the application:

- Figure(s) **6,7** described in the specification.

I. Should applicant contend that the above-noted omitted item(s) was in fact deposited in the U.S. Patent and Trademark Office (USPTO) with the nonprovisional application papers; a copy of this Notice and a petition (and $130.00 petition fee *(37 CFR 1.17(h))*) with evidence of such deposit **must** be filed within **TWO MONTHS** of the date of this Notice. The petition fee will be refunded if is determined that the item(s) was received by the USPTO.

II. Should applicant desire to supply the omitted item(s) and accept the date that such omitted item(s) was filed in the USPTO as the filing date of the above-identified application, a copy of this Notice, the omitted item(s) (with a supplemental oath or declaration in compliance with 37 CFR 1.63 and 1.64 referring to such items), and a petition under 37 CFR 1.182 (with the $130.00 petition fee *(37 CFR 1.17(h))* requesting the later filing date **must** be filed within **TWO MONTHS** of the date of this Notice.

III. The failure to file a petition (and petition fee) under the above options (I) or (II) within **TWO MONTHS** of the date of this Notice (37 CFR 1.181(f)) will be treated as a constructive acceptance by the applicant of the application as deposited in the USPTO. **THIS TWO MONTH PERIOD IS NOT EXTENDABLE UNDER 37 CFR 1.136(a) or (b)**. In the absence of a timely filed petition in reply to this Notice, the application will maintain a filing date as of the date of deposit of the application papers in the USPTO, and original application papers (*i.e.*, the original disclosure of the invention) will include only those application papers present in the USPTO on the date of deposit.

In the event that applicant elects not to take action pursuant to options (I) or (II) above (thereby constructively electing option (III)), amendment of the specification to renumber the pages consecutively and cancel incomplete sentences caused by any omitted page(s), and/or amendment of the specification to cancel all references to any omitted drawing(s), relabel the drawing figures to be numbered consecutively (if necessary), and correct the references in the specification to the drawing figures to correspond with any relabelled drawing figures, is required. Any drawing changes should be accompanied by a copy of the drawing figures showing the proposed changes in red ink. Such amendment and/or correction to the drawing figures, if necessary, should be by way of preliminary amendment submitted prior to the first Office action to avoid delays in the prosecution

of the application.

A copy of this notice <u>MUST</u> be returned with the reply.

Customer Service Center
Initial Patent Examination Division (703) 308-1202
PART 1 - ATTORNEY/APPLICANT COPY

SEP 04 2001
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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SEP 06 2001
Technology Center 2100

In re Application of SINGHAL et al.

Serial No. 09/848,662 Examiner: Not Assigned

Filed: May 3, 2001 Group Art Unit: 2182

For: LOCATION-AWARE SERVICE PROXIES IN A SHORT-RANGE WIRELESS ENVIRONMENT

CERTIFICATE UNDER 37 CFR 1.8(a)
I hereby certify that this correspondence is being deposited with the U.S. Postal Service as First Class mail in an envelope addressed to the Asst. Commissioner of Patents, Washington, D.C., 20231 on Aug 28, 2001.

Reg. No. 41,039
Glenn E. Gold

DATE: Aug 28, 2001

TRANSMITTAL LETTER

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Please find enclosed for filing:

X Petition / Response to Notice of Omitted Items (2 Pages)
X Copy of Notice of Omitted Items (2 Pages)
X Petition Fee ($130.00)

X Copy of Application Serial No. 09/848,662 (21 Pages)
X Copy of previously-filed informal drawings, FIGS. 1-5, corresponding to Application Serial No. 09/848,662 (5 Sheets)
X Copy of previously-filed Declaration and POA for Application Serial No. 09/848,662 (4 Pages)
X Copy of PostCard and Previous Transmittal for 09/848,662 (4 Pages)

X Copy of Application Serial No. 09/848,441 (18 Pages)
X Copy of previously-filed informal drawings, FIGS. 1-7, corresponding to

Application Serial No. 09/848,441 (7 Sheets)

X Copy of previously-filed Declaration and POA for Application Serial No. 09/848,441 (4 Pages)

X Copy of PostCard and Previous Transmittal for 09/848,441(4 Pages)

This Transmittal Letter is submitted in duplicate.

Respectfully submitted,

Date: Aug. 27, 2004

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Telephone: (561) 799-6630

Attorney Docket: 6020.0200

DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

LOCATION AWARE SERVICE PROXIES
IN A SHORT-RANGE WIRELESS ENVIRONMENT

the specification of which

(check one)
[X] is attached hereto

[ ] was filed on _____ as Application Serial No.
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I do not know and do not believe that the invention was ever patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application.

I do not know and do not believe that the invention was in public use or on sale in the United States of America more than one year prior to this application.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known by me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also

identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes	[ ] No
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes	[ ] No

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known by me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

09/637,742 (Application Serial No.)	08/11/2000 (Filing Date)	Pending (Status) (patented, pending, abandoned)
09/657,745 (Application Serial No.)	09/10/2000 (Filing Date)	Pending (Status) (patented, pending, abandoned)

As a named inventor, I hereby appoint the following attorneys or agents to prosecute this application and transact all business in the United States Patent and Trademark Office connected therewith:

Glenn E. Gold	Registration No. 41,039
Marcia L. Doubet	Registration No. 40,999

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Direct telephone calls to: Glenn Gold
(561) 799-6630

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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LOCATION-AWARE SERVICE PROXIES IN A SHORT-RANGE WIRELESS ENVIRONMENT

Cross Reference to Related Applications

This application is co-pending with and claims pursuant to 35 U.S.C. § 120 as to its common subject matter the filing date of patent application serial number 09/637,742, filed August 11, 2000, and patent application serial number 09/657,745, filed September 10, 2000.

Background of the Invention

Field of the Invention

The invention relates generally to wireless networks, and more particularly to the delivery of location-based services in an intra-building environment through the use of short-range wireless technology.

Description of the Prior Art

Short-range wireless technologies such as 802.11, Bluetooth, HomeRF, and others are being rapidly deployed to allow mobile devices to connect with existing intra-building wired Local Area Networks (LANs). To enable this connectivity, wireless access points are being developed by various manufacturers. An example of such an access point is the Aironet 340 access point (an 802.11 type access point) manufactured by Cisco Systems, Inc. of San Jose, California. Another example is the AXIS 9010 access point (a Bluetooth type access point) manufactured by Axis Corporation of Lund, Sweden. Short-range wireless access points deliver connectivity over a

small radius, i.e., a radius that is typically 100 meters or less.

At the same time, a wide variety of location-based services have been developed over wide-area cellular networks. These services include: (1) emergency location services (commonly referred to as "E-911" services); (2) consumer information services, such as locating the nearest restaurant, gas station or parking spot; and (3) mapping services for determining the optimal route to a particular destination. These location-based services are implemented by determining the user's location through queries to a cellular base station or Home Location Register (HLR) at the cellular service provider. Alternatively, implementation is achieved via triangulation of critically located points obtained through multiple base stations. The resolution of such location determinations is typically on the order of a few hundred meters.

Cellular service coverage is often limited in intra-building environments, making existing location-based services, and indeed wide-area services, generally inaccessible. Moreover, the granularity of location information, which is hundreds of meters, is too coarse to be useful for intra-building location-based services. There are myriad types of intra-building location-based services. By way of example, these services may include: (1) locating the nearest computer printer or the nearest projector; (2) locating the nearest person meeting a particular characteristic, such as the nearest cardiologist in a hospital environment; and (3) locating the nearest restroom. For such intra-building requests, users require location-based services having the capability of providing answers within a granularity on the order of tens of meters. Clearly, existing wide-area location-based services are insufficient for this task.

Therefore, what is needed is a system and method for delivering location-based services in an intra-building environment. The method must provide reliable coverage within the building and must deliver service with a fine level of granularity.

Summary of the Invention

It is an object of the present invention is to provide a system and method for delivering location-based services in an intra-building environment using short-range wireless technology.

It is another object of the present invention to deliver intra-building location-based services having a fine level of granularity, at least on the order of tens of meters.

It is a further object of the present invention to provide a system and method for delivering such intra-building services, wherein the services are enabled through the deployment of "location-aware service proxies" that intercept requests initiated by mobile clients and, subsequently, deliver location sensitive information to the user.

A network system is provided comprising: at least one mobile client; one or more short-range wireless access points; software operating on directly on these access points or, alternatively, on one or more adapters coupled to these access points; a location registry; and a plurality of location-aware service proxies.

The software on each access point, or coupled adapter as the case may be, monitors the traffic generated by the wireless clients on the associated access point. Using the software, the location registry receives notifications relating to client presence. A plurality of location-aware service proxies are provided for intercepting a client's request and, subsequently,

generating corresponding responses incorporating location sensitive information for the requesting client.

Brief Description of Drawings

The preferred embodiments of the invention will hereinafter be described in conjunction with the appended drawings provided to illustrate and not to limit the invention, where like designations denote like elements, and in which:

FIG. 1 is a block diagram illustrating a network having access points, a location Registry and a location-aware service proxy in accordance with the present invention;

FIG. 2 is a flow chart illustrating a method of using the system of FIG. 1, in accordance with a preferred embodiment of the present invention;

FIG. 3 is a flow chart illustrating a typical query process with a mobile client, in accordance with the present invention;

FIG. 4 is a block diagram of a location-aware service proxy in accordance with the present invention; and

FIG. 5 is a flow chart illustrating a method of handling a request in accordance with the location-aware service proxy of the present invention.

Detailed Description of Preferred Embodiments

Referring now to FIG. 1, a plurality of mobile clients 100 equipped with short-range wireless communication devices (not shown) reside within one or more Local Area Networks (LANs) 106. Each LAN includes a plurality of short-range wireless access points 101, each capable of communicating with the communication device carried by mobile clients 100. Software is incorporated

into the access points 101 or, alternatively, into an adapter 104 coupled to the access points 101. As used herein, the term "adapter" is generally defined as any device which provides an interface between separate networks. The software communicates information to a location registry 102 which functions to track the location of each active client 100. The location registry 102 also maintains a table 105 listing the current access point(s) associated with each client Medium Access Control (MAC) address. A plurality of location-aware service proxies 103 communicate with the location registry 102.

In a preferred embodiment of the present invention, the software located on each access point 101, or on each adapter 104, as the case may be, monitors the traffic generated by the wireless clients 100 thereon. When a new client device is detected on an access point 101, a register notification is communicated to the location registry 102. The notification includes a unique identifier (ID) associated with the access point 101, and a unique identifier (ID) associated with the client device. Preferably, the unique ID associated with both the access point 101 and the client device comprises the corresponding MAC address.

Upon making a determination that a previously recognized client device is no longer present at a particular access point 101, a reverse registration notification is communicated to the location registry 102. As used herein, the terms "reverse registration" and "registration reversal" are intended to generally describe the removal or deletion of a previous registration. The reverse registration notification contains a unique identifier (ID) associated with the access point 101 and the client device; again, the unique ID preferably comprises the respective MAC addresses.

Alternatively, the above-described notifications can be transmitted via less reliable communications means. However, in that where such alternate communication means are utilized, packets are retransmitted if no acknowledgement is received within a predefined suitable timeout period. Methods for achieving such reliability where unreliable communication means are employed are well known in the art. In this case, the register notification preferably includes a timestamp or sequence number, enabling the location registry 102 to detect, and subsequently discard, duplicate packets.

A variety of different methods are known in the art for determining a client device arrival at, or departure from, an access point. In the preferred embodiment of the present invention, the access points 101, or adapters 104 coupled to the access points, maintain an Active Client List containing the MAC addresses associated with active clients. When network traffic is received from a mobile client whose MAC address is not on the Active Client List, the client is assumed to be present, and the corresponding MAC address is added to the Active Client List. If traffic has not been received within a predefined timeout period, from a mobile client whose MAC address is on the Active Client List, the client is assumed to have departed. In that case, the corresponding MAC address is deleted from the Active Client List. Whenever a new device is detected, a register notification is communicated to the location registry 102. When a device is no longer detected, a reverse registration notification is communicated to the location registry 102.

In an alternate embodiment of the present invention, the software on an access point 101 or adapter 104 periodically transmits a register notification identifying all clients that are currently visible to that particular access point. In this alternate embodiment of the invention, the register notification

contains the contents of the Active Client List. Furthermore, the location registry 102 automatically removes registrations of clients having identities provided in a register notification but not included in a subsequent register notification.

Preferably, the location registry 102 is located at a central location or host. Alternatively, however, the location registry can be co-located with an access point 101, an adapter 104, or a service proxy 103.

In a further aspect of the invention, the location registry 102 can be stored over a cluster of processors or in a distributed manner so as to efficiently utilize storage, processing power, network bandwidth or other resources. One benefit of such a distributed implementation is that it achieves improved fault tolerance during the occurrence of network or system failures.

In another aspect of the invention, the functionality of access point 101 or adapter 104 is enhanced to include additional relevant information, pertaining to the mobile client 100, within each registration message to the location registry 102. The location registry 102 can then provide this information as part of its response to a location query. For example, the registration message might include information pertaining to the type of mobile client, its user, or its network characteristics.

Referring now primarily to FIG. 2 in conjunction with FIG. 1, an exemplary method for generating and processing registration and reverse registration messages is provided.

Initially, as shown generally at step 200, a local access point 101 detects the arrival of a mobile client 100 to the network. Subsequently, as shown generally at step 201, the local access point 101 transmits a register notification to the location registry 102. The location registry 102 maintains a table 105 listing the access point(s) currently associated with

each client ID. As shown generally at step 202, upon receiving the register notification, the location registry adds the corresponding access point ID to the list of locations at table 105 for the associated client ID, unless the access point is determined to be currently registered. As shown generally at steps 203-205, when a mobile client moves beyond the detectable range of a local access point, the local access point detects 203 the departure of the mobile client, transmits 204 a reverse registration notification to the location registry 102 and, upon receiving the reverse registration notification, the location registry removes 205 the corresponding access point ID from the list of locations for the associated client ID.

The present invention can include one or more location-aware service proxies 103. Each service proxy 103 is responsible for receiving client requests of a particular type and subsequently generating one or more responses incorporating location-sensitive information for the requesting client. The location registry 102 exposes a query protocol through which location aware service proxies 103 can query for the location(s) associated with a particular client ID.

Referring now primarily to FIG. 3, a preferred method for request processing by a location aware service proxy 103 is described.

Initially, as shown generally at step 300, the location-aware service proxy 103 issues a request for information from the Location Registry 102, including the client ID for which the information is being requested. Subsequently, as shown generally at step 301, upon receiving the information request, the location registry 102 accesses the table 105 entry associated with the client ID contained in the query request, and retrieves the list of access point IDs associated with the client ID. Finally, as shown generally at step 302, the location registry

issues a response to the location aware service proxy, including the list of access point Ids retrieved from table 105.

In an alternative embodiment of the invention, the location registry 102 may be programmed with additional information about the location of access points, including the geographic coordinates or building and room number associated therewith. When available, this information can be returned as part of the response sent to the Location Aware Service Proxy in step 302. Referring now primarily to FIG. 4, the various components of the location aware service proxy 103 will be described in more detail. A request-handling interface 400 is provided for intercepting and interpreting requests from the mobile client 100. A location-aware service module 401 is provided for determining appropriate service information based upon a user location obtained through a query request 300 to the location registry 102. An optional request-forwarding interface 402 can be provided for forwarding client requests to a third-party information source 404. An optional response-receiving interface 403 can be provided for receiving responses from third-party information source 404. A response generator 405 is provided for fashioning a client response based upon the appropriate location-based service information and the optional service response from third-party information source 404. A response-forwarding interface 406 is provided for forwarding the generated response to the mobile client 100.

Referring now primarily to FIG. 5, the preferred location aware service proxy method will now be described in more detail. Initially, A mobile client request is received by request handling interface, as shown generally at step 500. Subsequently, the location-aware service module determines the client location by issuing a query to the location registry, as shown generally at step 501. Subsequently, as shown generally

at step 502, the location-aware service module determines the best means for handling the request, based upon the information contained in the request and the location information obtained from the location registry. Subsequently, as shown generally at step 503, the module determines whether or not satisfying the client query requires interfacing with a third-party information source. If third-party information is required, a request is issued 504 to the third party information source from the request forwarding interface, the third-party information source generates and transmits 505 the requested information, the request-receiving interface receives 506 a response from the third-party information source, and the response generator creates 507 a corresponding response for, and transmits 508 the response to, the client. If third-party information is not required as determined at step 503, only steps 507 and 508 are performed.

As will be apparent to those skilled in the art, steps 504-506 can be repeated when information from multiple third-party information sources has to be obtained by the location aware service proxy.

In an alternative embodiment of the method of FIG. 5, the decision logic of blocks 503-506 can occur prior to block 501. For example, information can be initially obtained from a third-party information source, then, according to the received information, location information can be retrieved to customize a client response.

This present invention can be used in conjunction with a Protocol Proxy and Data Manipulation Server (DMS), such as that described in commonly assigned U.S. Patent _____ (serial number 09/_____, filed concurrently herewith and incorporated herein by reference, entitled "Techniques for Enabling Remote Data Access and Manipulation from a Mobile

Device." As disclosed therein, a Protocol Proxy intercepts mobile client requests and, using service information obtained from the Data Manipulation Server, annotates the returned content with available services based on a plurality of criteria, possibly including location. These Protocol Proxies may be used in conjunction with the present invention by annotating the content returned from a Location Aware Service Proxy with these additional services. The Protocol Proxy may employ the query interface of the Location Registry defined herein to obtain location information about the mobile client. Moreover, a Location Aware Service Proxy, as disclosed herein, may also function as a Protocol Proxy. In this latter case, the Location Aware Service Proxy preferably performs further location-sensitive filtering on the available service list obtained from the DMS. Alternatively, the Location Aware Service Proxy may transmit location information (obtained from the Location Registry) to the DMS, where the DMS then factors that information into its service list-generation processing.

In the preferred embodiment, the following Location Aware Service Proxies 103 are provided:

(1) A Hypertext Transfer Protocol (HTTP) proxy which receives a plurality of HTTP requests transmitted by the clients and generates location-based content. For instance, the content can be based on information obtained from an external server identified in the HTTP request. By way of example, the HTTP proxy might receive a request for a location-based map. Upon receiving the request, the proxy obtains the location of mobile client 100. Based upon the client location, the proxy 103 generates (or otherwise obtains) a map, which is then forwarded back to the requesting client. Alternatively, the HTTP proxy can determine what, if any, additional services are available to the client in that location, e.g., available equipment such as a

printer or projector. Preferably, this information is obtained by querying an optional resource location registry (such as a Data Manipulation Server as described in the above-identified commonly-assigned patent application serial number 09/_____, filed concurrently herewith), which can be co-located with the location registry 102 of the present invention. Links to these services can be added to the response document, for subsequent transmission back to the requesting client.

(2) A Wireless Session Protocol (WSP) proxy which receives WSP requests transmitted by the clients and generates location-based content, e.g., based on information obtained from an external server identified in the WSP request. The Wireless Session Protocol (WSP) is defined as part of the Wireless Application Protocol (WAP). More information about WSP can be found at http://www.wapforum.org. By way of example, the WSP proxy could receive a request for a location-based map. Upon receiving the request, the proxy obtains the location of mobile client 100. Based on this location, the proxy 103 generates (or otherwise obtains) a map which is then forwarded back to the requesting client. Alternatively, this proxy could determine the availability of additional client at the location. Preferably, this information is obtained by querying an optional resource location registry (such as a Data Manipulation Server as described in the above-identified commonly-assigned patent application serial number 09/_____, filed concurrently herewith), which can be co-located with the location registry 102 of the present invention. Links to these services can be added to the response document, for subsequent transmission back to the requesting client.

(3) A DNS proxy which receives a plurality of DNS requests transmitted by the clients. The DNS proxy determines whether the requested hostname corresponds to a location-based service

and, if so, determines the appropriate IP address according to the client's location. The client's location is obtained from the location registry 102, while the IP address is obtained from a resource location registry. If the requested hostname does not correspond to a location-based service, the DNS proxy forwards the request to the default DNS server. By way of example, when the user requests the IP address for a host named "printer," the DNS proxy determines the client's current location and returns the IP address of the nearest printer. However, when the user requests the IP address for a host named "www.reefedge.com," the DNS proxy forwards the request to the default DNS server to determine the address of www.reefedge.com. The DNS proxy can also be used to support locally-available services, such as "login" or "search" services.

(4) A message proxy which receives a query for current messages from the mobile clients. The message proxy obtains a list of current messages by issuing a query to a message server. The mobile client's 100 location is obtained from the location registry 102, and the list of current messages is filtered according to the client location. In this manner, delivery of a particular message can be delayed until a client has reached a particular location, or until a client has exited from a particular location.

(5) A directory proxy which receives a query for directory information from the mobile clients. The directory proxy obtains information about the requested user. The user's location is then obtained from the location registry 102, and the information is included in the response provided to the mobile client. In this manner, directory queries are automatically augmented with information about the location of the queried user. In the preferred embodiment, the directory proxy supports the LDAP (Lightweight Directory Access Protocol)

protocol. The LDAP protocol is described in RFC 1777 available at http://www.rfceditor.org. The directory proxy can also be implemented as an HTTP proxy that responds to requests received via the HTTP protocol. Alternative embodiments can employ other protocols for receiving directory queries.

By practicing the system and methods of the present invention, a client host is completely shielded from the necessity to explicitly query for location-based services in an intra-building environment.

While the preferred embodiments of the invention have been illustrated and described, it will be clear that the invention is not limited to these embodiments only. Numerous modifications, changes, variations, substitutions and equivalents will be apparent to those skilled in the art without departing from the spirit and scope of the invention as described in the claims.

What is Claimed is:

1. A system for delivering location-based services to mobile clients in a building structure using short-range wireless technology, comprising:

a plurality of short-range wireless communication devices, each of the mobile clients equipped with at least one of said devices;

a plurality of short range wireless access points adapted for communicating with said mobile clients via said short-range wireless communication devices;

a location registry having means for tracking the location of said mobile clients;

access point software for enabling the communication of information to said location registry; and

one or more location aware service proxies.

2. A system as recited in claim 1, wherein said access point software is maintained on an adapter coupled to said wireless access points.

3. A system as recited in claim 1, further comprising an active client list maintained by at least one of said wireless access points and said adapters coupled to said wireless access points, said active client list containing Medium Access Control (MAC) addresses for said active clients.

4. A system as recited in claim 1, wherein said wireless access points include means for detecting the identity of a system user.

5. A system as recited in claim 1, wherein said wireless access points have means for detecting one or more mobile client characteristics.

6. A system as recited in claim 1, wherein said location registry further comprises:

means for receiving notification information from said wireless access points; and

means for maintaining a table listing of wireless access points associated with each of said mobile clients.

7. A system as recited in claim 1, wherein said location aware service proxies each have means for intercepting client requests and means for generating responses incorporating location sensitive information.

8. A system as recited in claim 1, wherein said one or more location aware service proxies comprise at least one of: an HTTP proxy, a WSP proxy , a DNS proxy, a message proxy and a directory proxy.

9. A system as recited in claim 8 wherein said DNS proxy includes means for determining an IP address for a requested host name, said host name corresponding to a location-based service corresponding to a client location.

10. A system as recited in claim 8 wherein said message proxy includes means for filtering a list of current messages requested from said message server based upon client location.

11. A system as recited in claim 1, further comprising a protocol proxy, said protocol proxy annotating content received from said service proxy.

12. A system as recited in claim 1, wherein said location registry further comprises a query interface adapted for interfacing with the protocol proxy to give location information about a mobile client.

13. A system as recited in claim 1 wherein said location aware service proxy further comprises a protocol proxy.

14. A method for delivering location-based services to a a plurality of mobile clients located within a building structure using short-range wireless technology, the mobile clients each carrying a short-range wireless communication device, the method comprising the steps of:

establishing a plurality of short-range wireless access points having means for communicating with said mobile clients via said wireless communication devices;

communicating information from said access points to a location registry via access point software;

providing a plurality of location aware service proxies; and

continuously tracking the location of said mobile clients via said location registry.

15. A method as recited in claim 14, wherein the step of communicating further comprises communicating information from one more adapters coupled to said access points to a location registry.

16. A method as recited in claim 14, further comprising the step of continuously monitoring traffic generated by said mobile clients via said access point software.

17. A method as recited in claim 14, further comprising the step of transmitting a register notification from a wireless access point to said location registry upon detecting a new mobile client address on said wireless access point.

18. A method as recited in claim 14, further comprising the step of transmitting a reverse registration notification from a wireless access point to said location registry upon detecting a mobile client departure from said wireless access point.

19. A method as recited in claim 16, further comprising the step of monitoring the quantity of time lapsed since the previous detection of traffic for each of said active mobile clients.

20. A method as recited in claim 19, further comprising the step of defining a mobile client departure from a wireless access point based upon said time lapse.

21. A method as recited in claim 14, further comprising the step of transmitting register notifications from a wireless access point to said location registry at timed intervals, said register notification including a list of all mobile clients actively communicating with said access point, said location registry defining a mobile client address as unregistered where the client is not included on the active mobile client list.

22. A method as recited in claim 14, further comprising the step of maintaining an active client list associated with each access point, each active client list including the corresponding MAC addresses.

23. A method as recited in claim 22, further comprising the step of adding a MAC address of a mobile client upon detection of network traffic from said mobile client.

24. A method as recited in claim 22, further comprising the step of deleting a MAC address of a mobile client upon failure to detect respective client traffic within a predetermined time period.

25. A method as recited in claim 14, further comprising the step of transmitting notification information from said wireless access points to said location registry, said location registry maintaining a table listing of current access points associated with each of the mobile clients.

26. A method as recited in claim 14, further comprising the step of enhancing the functionality of an access point to identify a system user or a mobile client characteristic.

27. A method as recited in claim 17, further comprising the step of adding an access point ID to a location list for a particular client ID upon receiving a registry notification.

28. A method as recited in claim 17, further comprising the step of removing an access point ID from the location list for a particular client ID upon receiving a reverse registry notification.

29. A method as recited in claim 14, further comprising the steps of:

intercepting client requests via said location aware service proxies; and

generating responses incorporating location sensitive information via said location aware service proxies.

30. A method as recited in claim 14 wherein the location aware service proxy further comprises a DNS proxy, the method further comprising the step of determining an IP address for a requested host name corresponding to a location-based service based upon a client location.

31. A method as recited in claim 14 wherein the location aware service proxy further comprises a message proxy, the method further comprising the step of filtering a list of current messages received from a message server, based upon a client location, via said message proxy.

32. A method as recited in claim 14, further comprising the step of annotating content received by said protocol from said location aware service proxy.

Abstract

A system and a method for delivering location sensitive services within a short-range wireless environment. Service proxies are employed to customize queried information and make available services according to user identity and location.

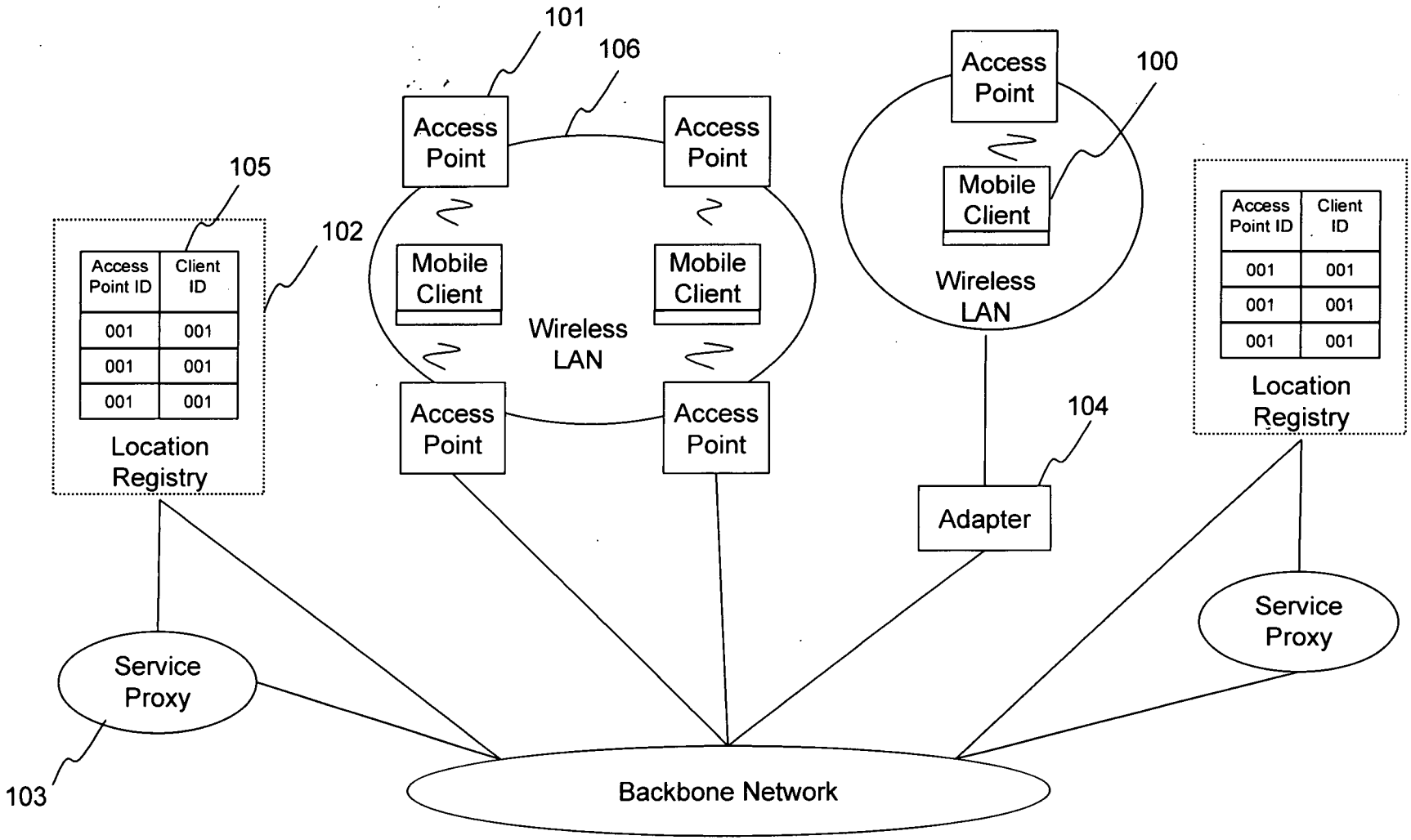

101
106
Access Point
Access Point
Mobile Client
Mobile Client
Wireless LAN
Access Point
Access Point
105
102
Access Point ID
Client ID
001
001
001
001
001
001
Location Registry
Access Point
100
Mobile Client
Wireless LAN
104
Adapter
Access Point ID
Client ID
001
001
001
001
001
001
Location Registry
Service Proxy
Service Proxy
103
Backbone Network

FIG. 1

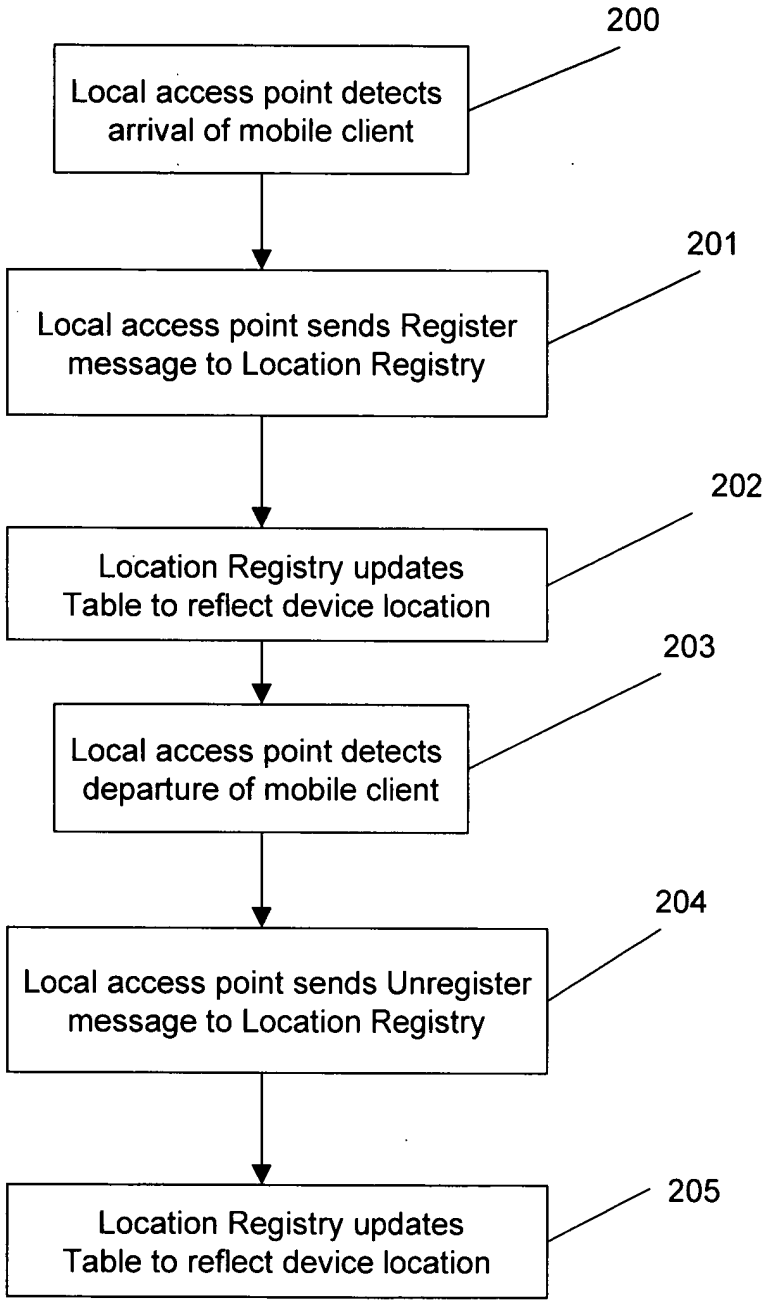

200
Local access point detects arrival of mobile client
201
Local access point sends Register message to Location Registry
202
Location Registry updates Table to reflect device location
203
Local access point detects departure of mobile client
204
Local access point sends Unregister message to Location Registry
205
Location Registry updates Table to reflect device location

FIG. 2

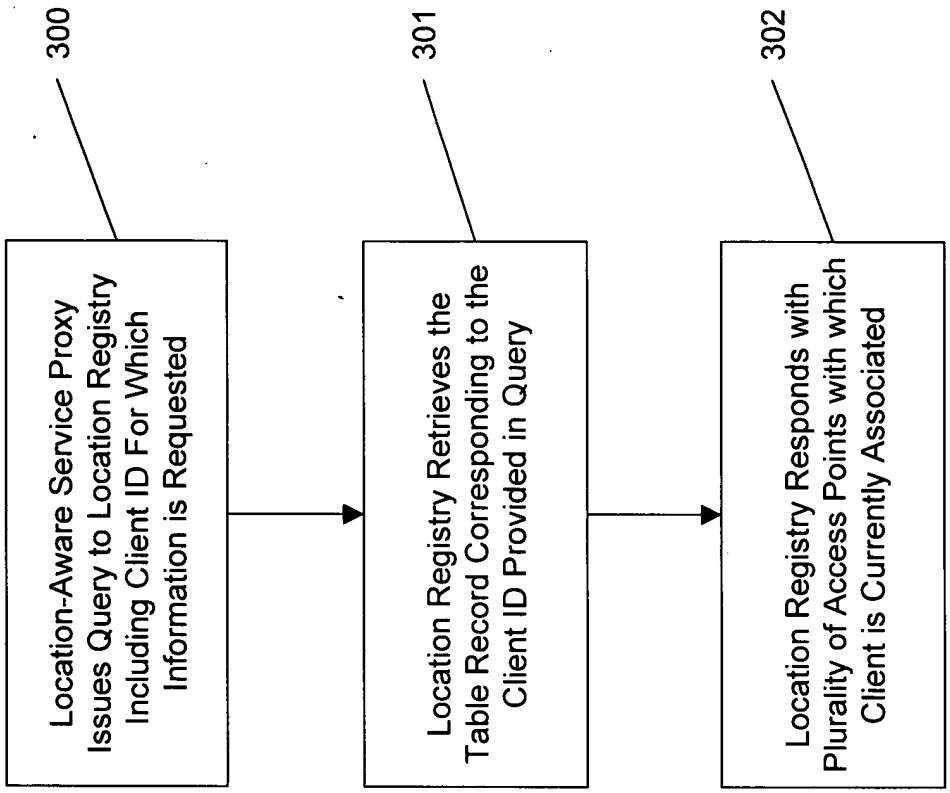

300
Location-Aware Service Proxy Issues Query to Location Registry Including Client ID For Which Information is Requested
301
Location Registry Retrieves the Table Record Corresponding to the Client ID Provided in Query
302
Location Registry Responds with Plurality of Access Points with which Client is Currently Associated

FIG. 3

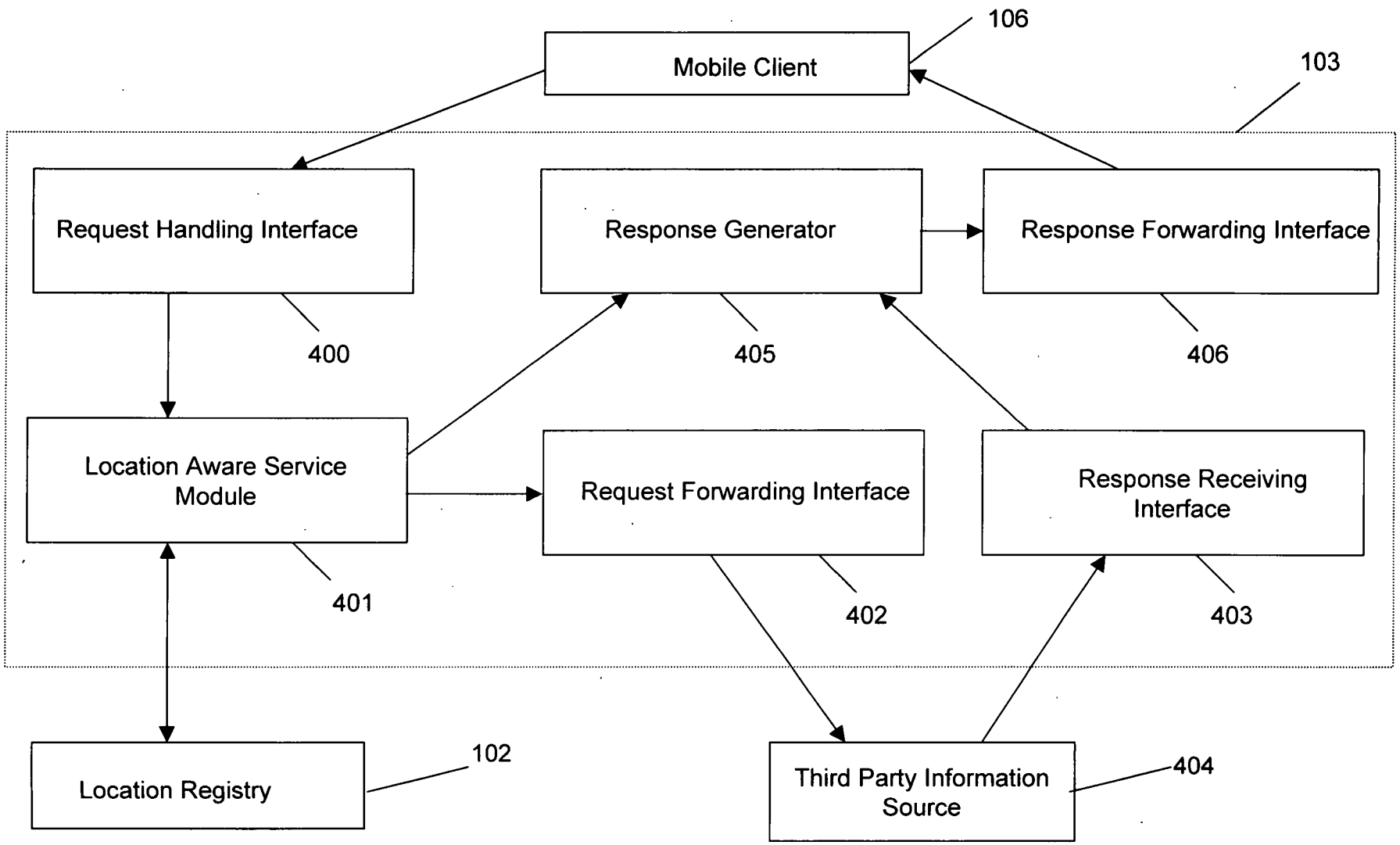

Mobile Client
106
103
Request Handling Interface
Response Generator
Response Forwarding Interface
400
405
406
Location Aware Service Module
Request Forwarding Interface
Response Receiving Interface
401
402
403
Location Registry
102
Third Party Information Source
404

FIG. 4

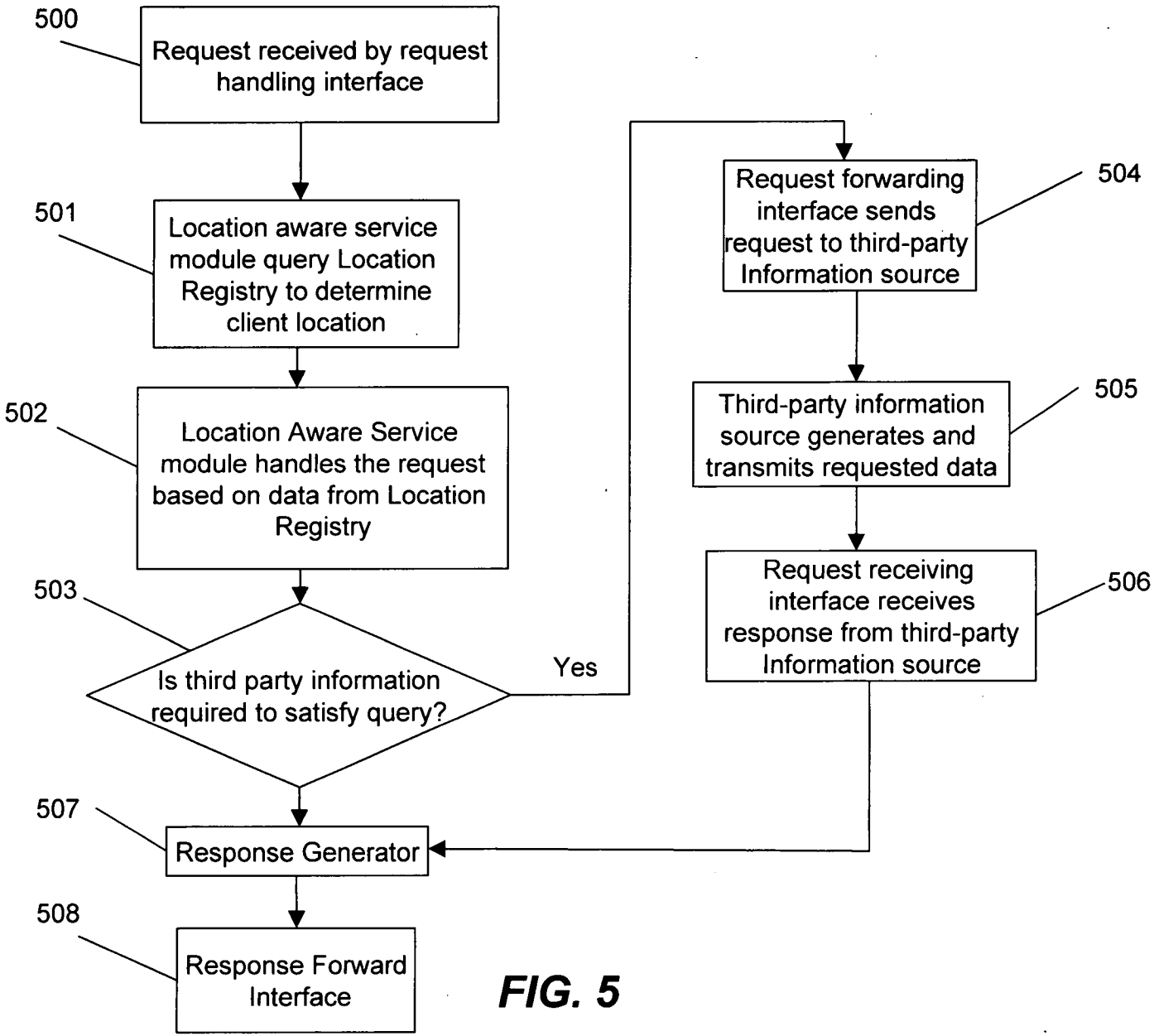

500
Request received by request handling interface
501
Location aware service module query Location Registry to determine client location
502
Location Aware Service module handles the request based on data from Location Registry
503
Is third party information required to satisfy query?
Yes
504
Request forwarding interface sends request to third-party Information source
505
Third-party information source generates and transmits requested data
506
Request receiving interface receives response from third-party Information source
507
Response Generator
508
Response Forward Interface

FIG. 5

Docket No. 6020.0200

Applicant(s) : Singhal, et al.

For : METHOD AND SYSTEM FOR ADAPTING SHORT-RANGE WIRELESS ACCESS POINTS FOR PARTICIPATION IN A COORDINATED NETWORKED ENVIRONMENT

EXPRESS MAIL CERTIFICATION

"Express Mail" mailing label number ET431527393US.

Date of Deposit May 3, 2001

I hereby certify that this transmittal letter and the other papers and fees identified in this transmittal letter as being transmitted herewith are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above and are addressed to the Hon. Commissioner for Patents, Washington, D.C. 20231.

Glenn E. Gold

Hon. Commissioner
for Patents
Washington, D.C. 20231

TRANSMITTAL LETTER FOR
ORIGINAL PATENT APPLICATION

Sir:

Transmitted herewith for filing are the [X] specification; [X] claims; [X] abstract; [X] declaration; [X] power of attorney; [X] assignment, for the above-identified patent application.

Also transmitted herewith are:

[X] 5 sheets of:

[ ] Formal drawings.

[X] Informal drawings. Formal drawings will be filed during the pendency of this application.

[ ] Certified copy(ies) of application(s)

(country)	(appln. no.)	(filed)
(country)	(appln. no.)	(filed)
(country)	(appln. no.)	(filed)

from which priority is claimed.

[X] An assignment of the invention to ReefEdge, Inc., 2 Executive Drive, Suite 600, Fort Lee, N.J., 07024.

[X] A check in the amount of $40.00 to cover the recording fee.

[ ] Please charge $40.00 to Deposit Account No._____ in payment of the recording fee. A duplicate copy of this transmittal letter is transmitted herewith.

[ ] An associate power of attorney.

The filing fee has been calculated as shown below:

FOR	NUMBER FILED		NUMBER EXTRA	RATE	FEE
BASIC FEE					$355.00
TOTAL CLAIMS	33	- 20 =	13	X $ 9 =	$117.00
INDEPENDENT CLAIMS	2	- 3 =	0	X $ 40 =	$
[ ] MULTIPLE DEPENDENT CLAIMS				+ $135 =	$
				TOTAL	$ 472.00

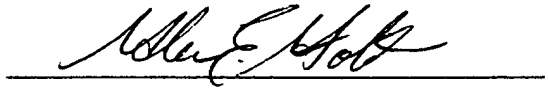
[X] A check in the amount of $ 472.00 in payment of the filing fee is transmitted herewith.

[ ] This application is being filed unaccompanied by a filing fee. The appropriate filing fee will be paid in response to a Notice to File Missing Parts, pursuant to 37 C.F.R. § 1.53(f).

[ ] The Commissioner is hereby authorized to charge payment of any additional filing fees required under 37 C.F.R. § 1.16, in connection with the paper(s) transmitted herewith, or credit any overpayment of same, to deposit Account No. 06-1075. A duplicate copy of this transmittal letter is transmitted herewith.

[ ] Amend the specification by inserting before the first line the sentence: -- This is a [ ] continuation-in-part, of application Serial No.: _____, filed _____ entitled _____ _____ _____ _____.

[ ] Please charge $_____ to Deposit Account No. 06-1075 in payment of the filing fee. A duplicate copy of this transmittal letter is transmitted herewith.



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Registration No.41,039

Attorney for Applicant

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Serial No.: _____ Docket No.: 6020.0100

Client: REEFERGE, INC.

Assistant Commissioner for Patents

Sir:

Please acknowledge receipt of the paper(s) noted hereon by stamping the date received and returning this card to the undersigned.

Respectfully,

Glenn Gold, P.A.

- ☒ Application 21 PAGES — 18 pages (wrong appl.)
- ☐ Submission ~~of Formal~~ Drawings
- ☒ 7 Sheets of Drawings (1 sets)
- ☒ Filing Fee ($ 463) — $472.00
- ☐ Amendment/~~Response~~
- ☐ Request for Extension of Time
- ☒ Assignment & RECORDAL COVER SHEET (6PGS)
- ☐ Verified Statement
- ☒ Transmittal Letter (3PGS.)
- ☐ PTOL-85B
- ☐ Information Disclosure Statement
- ☒ Signed Declaration & P.O.A (41PGS.)
- ☒ Record Fee $40.00.
- ☐ _____
- ☐ _____

J1036 U.S. PTO
09/848441
05/03/01

DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND SYSTEM FOR ADAPTING SHORT-RANGE WIRELESS ACCESS POINTS FOR PARTICIPATION IN A COORDINATED NETWORKED ENVIRONMENT

the specification of which

(check one)
[X] is attached hereto
[ ] was filed on _____ as Application Serial No.
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I do not know and do not believe that the invention was ever patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application.

I do not know and do not believe that the invention was in public use or on sale in the United States of America more than one year prior to this application.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known by me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for

patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

			Priority Claimed
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes [ ] No
(Number)	(Country)	(Day/Month/Year Filed)	[ ] Yes [ ] No

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known by me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

09/637,742 (Application Serial No.)	08/11/2000 (Filing Date)	Pending (Status) (patented, pending, abandoned)
09/657,745 (Application Serial No.)	09/10/2000 (Filing Date)	Pending (Status) (patented, pending, abandoned)

As a named inventor, I hereby appoint the following attorneys or agents to prosecute this application and transact all business in the United States Patent and Trademark Office connected therewith:

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Marcia L. Doubet Registration No. 40,999

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Plantation, FL 33324

Direct telephone calls to: Glenn Gold
(561) 799-6630

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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METHOD AND SYSTEM FOR ADAPTING SHORT-RANGE WIRELESS ACCESS POINTS FOR PARTICIPATION IN A COORDINATED NETWORKED ENVIRONMENT

Cross Reference to Related Applications

This application is co-pending with and claims pursuant to 35 U.S.C. § 120 as to its common subject matter the filing date of patent application serial number 09/637,742, filed August 11, 2000, and patent application serial number 09/657,745, filed September 10, 2000.

Background of the Invention

Field of Invention

The invention relates generally to wireless networks, and more particularly to an adapter method for extending stand-alone wireless access points to enable their delivery of an integrated solution within a network environment.

Description of the Prior Art

Short-range wireless technologies such as 802.11, Bluetooth, HomeRF, and others are being rapidly deployed to allow mobile devices to connect with existing intra-building wired Local Area Networks (LANs). To enable this connectivity, wireless access points are being developed by various manufacturers. An example of such an access point is the Aironet 340 access point (an 802.11 type access point) manufactured by Cisco Systems, Inc. of San Jose, California. Another example is the AXIS 9010 access point (a Bluetooth type access point) manufactured by Axis Corporation of Lund, Sweden.

Traditional wireless access points provide limited functionality, essentially limited to enabling a so-called "hotspot" of connectivity to the LAN. The access point operates

by forwarding data packets from the wireless environment to the wired LAN, and vice versa. However, within an environment containing multiple access points, conventional stand-alone access points have several limitations. For example, a stand alone access point: (1) cannot be centrally managed; (2) cannot support layer 3 (IP) roaming with other access points; (3) cannot enforce quality-of-service (QoS) metrics; (4) cannot deliver centralized logging and reporting; and (5) provides only limited security and authentication capability, and no server managed security.

Existing efforts to address the aforementioned limitations involve the incorporation of new infrastructure into an existing network to provide some of the missing services for the access points. One example of this approach is the combination of a Cisco Aironet 350 access point and a Cisco Secure Access Control Server for delivery of authentication and dynamic encryption key generation services. Another example of this approach is the incorporation of a 3Com SuperStack II switch for delivery of authentication and virtual private networking (VPN) access to wireless users. Such conventional approaches have significant drawbacks and limitations. For example, these approaches require one or more of the following: (1) Mandatory software on the client devices (e.g., VPN software); (2) Particular versions of wireless client hardware or firmware, thereby forcing a homogeneous environment; (3) Upgrades to the existing wireless access points; and (4) Complex network configurations, since multiple pieces of infrastructure must be separately installed, configured and managed.

These requirements make deployment difficult, limit device choice, and do not provide a scalable approach to delivering all of the required services for the access points in an enterprise network. Accordingly, there is an established need for a system

overcoming the aforementioned drawbacks and limitations of prior art wireless access point systems.

Summary of the Invention

It is an object of the present invention to provide a network adapter for an access point within a networked environment.

It is another object of the present invention to provide a network adapter for a plurality of access points within a switched Local Area Network.

In a preferred embodiment of the invention, an adapter device is provided connected to each short-range wireless access point in a network. Each packet transmitted between an access point and the wired LAN passes through the adapter. The adapter may be implemented as a stand-alone Personal Computer (PC), a special-purpose computing appliance, or as a component that physically coupled to the access point, with the component / access point combination encapsulated within a single enclosure.

In one aspect of the invention, the adapter is implemented as a software component or module loaded into the memory of the access point. Preferably, the adapter comprises a wireline network interface, a wireless network interface, an IP stack and network coordination software.

In another aspect of the invention incorporated within a switched LAN environment, a single adapter device can support a plurality of short-range wireless access points.

Brief Description of the Drawings

The preferred embodiments of the invention will hereinafter be described in conjunction with the appended drawings provided to illustrate and not to limit the invention, where like designations denote like elements, and in which:

FIG. 1 is a block diagram of an adapter connecting wired and wireless networks, in accordance with the present invention;

FIG. 2 is a block diagram of an adapter, in accordance with the present invention;

FIG. 3 is a flow chart illustrating a method for forwarding a packet to a wireless interface, in accordance with the present invention;

FIG. 4 is a flow chart illustrating a method for forwarding a packet to a wire-line interface, in accordance with the present invention;

FIG. 5 is a block diagram of an adapter connected to a plurality of access points through a switch, in accordance with the present invention;

FIG. 6 is a block diagram illustrating three individual access point segments connected to a single adapter, in accordance with the present invention; and

FIG. 7 is a block diagram of an adapter connecting to access points from different wireless networks, in accordance with the present invention.

Detailed Description of Preferred Embodiments

Generally, a typical network environment consists of a network control server connected to a wired Local Area Network (LAN). The adapter's wireline network interface is connected to the Local Area Network and the adapter's wireless network interface is connected to an access point. The network control server is connected to the Local Area Network, which in turn is connected to the Internet backbone.

Referring now to FIGS. 1 and 2, one or more adapters 101 are provided connected to corresponding short-range wireless access point 100. In the preferred embodiment of the present

invention, adapter 101 has two network interfaces, a wireless network interface and a wireline network interface. The wireless network interface is connected directly to each access point 100, while the wireline network interface is connected directly to a local area network (LAN) 102 or, alternatively, to a switch/router (not shown in FIG. 1). In this manner, all packets sent between access point 100 and the wired LAN 102 must pass through the adapter 101.

The adapters 101 communicate with a Network Control Server (NCS) 103 which maintains information required by the adapters 101 in the networked environment. Preferably, the NCS 103 communicates with the adapters 101 via LAN 102. However, as will be apparent to those skilled in the art, the Network Control Server 103 can be attached directly to each adapter 101, or it can communicate with the adapters via a wide-area network (WAN), such as the Internet.

Adapter 101 can be implemented as a stand-alone personal computer (PC) or, alternatively, as a special-purpose computing appliance. Alternatively, the adapter 101 can be implemented as a component physically coupled to the access point 100, with the combination encapsulated within a single enclosure. In further aspects of the invention, the adapter 101 is implemented as a software component or module loaded into the memory of access point 100.

In an alternative embodiment of the present invention, adapter 101 functions with an existing wired LAN 102 port, instead of a short-range wireless access point 100. In this case, the adapter 101 is attached to a LAN port, and a client device or switch can be attached to the adapter's wireless network interface 201.

Commonly-owned pending U.S. patent application serial number 09/637,742, filed August 11, 2000, and incorporated

herein by reference, discloses a wireless networking system wherein a central core server resides in the network infrastructure and provides services to Handoff Management Points (HMPs) as users of devices roam through the environment. The system of the present invention can be implemented in combination with the above-identified related invention, wherein the network control server 103 is co-located with the core server or, alternatively, where the network adapters 101 are co-located with the HMPs. This combined configuration enables clients to travel seamlessly between access points that do not directly support coordination through the core server.

Commonly-owned pending U.S. patent application serial number 09/657,745, filed September 10, 2000, and incorporated herein by reference, discloses a system wherein a routing coordinator maintains a plurality of connection table records and wherein a plurality of Home Agent Masqueraders (HAMs) and Foreign Agent Masqueraders (FAMs) communicate with the routing coordinator to ensure that client data connections are preserved as the client travels throughout the short-range wireless network environment. Each of the connection table records includes a client address and port, and a server address and port. The system of the present invention can be implemented in combination with the above-identified related invention, where the network control server 103 is co-located with the routing coordinator or, alternatively, where the network adapters 101 are co-located with the HAMs and FAMs. The combined configuration enables clients to preserve network connections as they travel through a short-range wireless network environment and communicate with access points that do not directly support coordination through the routing coordinator.

Accordingly, the network control server 103 of the present invention can be co-located with the core server and/or the

routing coordinator of the above-identified commonly-assigned inventions. Moreover, the adapters 101 described in the present invention can be co-located with the HMP and/or the HAM or FAM of these commonly-assigned inventions.

As best depicted in FIG. 2, adapter 101 includes a wireline network interface 200, a wireless network interface 201, network coordination software 202, and an augmented IP stack 203.

Wireline network interface 200 can comprise an Ethernet, token ring or other any other local area network (LAN) known in the art. In the preferred embodiment of the present invention, network adapter 101 incorporates a single wireline network interface 200. However, as will be apparent to those skilled in the art, alternative embodiments of the present invention can include multiple wireline network interfaces, each connecting the adapter 101 to a different LAN.

Wireless network interface 201 can comprise an Ethernet connection, serial cable, RS232 or other cable connection to a wireless access point 100. Preferably, network adapter 101 incorporates a single wireless network interface 201. However, as will be apparent to those skilled in the art, alternative embodiments of the present invention can include multiple wireless network interfaces, each connecting the adapter 101 to a different wireless access point 100.

Network coordination software 202 is provided for communicating with the network control server 103 to provide coordination functions on behalf of the adapted access point 100 within the managed network environment. In the preferred embodiment of the present invention, the network coordination software 202 enables retrieval of network security and quality-of-service policies, retrieval of packet rewriting rules, transmission of logs and alerts, and dissemination of information pertaining to device arrival and departure.

Furthermore, the software receives management commands that are forwarded to the access point itself.

Augmented IP stack 203 comprises an IP stack that has been instrumented with particular features to enforce the managed network environment. In the preferred embodiment of the present invention, the aforementioned features include, but are not limited to, packet filtering and packet rewriting. The packet filtering feature prevents a packet from being forwarded to its intended destination, in accordance with the security, quality-of-service or other policies within the managed network environment. The packet rewriting feature rewrites a packet before it is forwarded to an intended destination, in accordance with the policies within the managed network environment. In the preferred embodiment of the present invention, the packet rewriting functions include Network Address Translation (NAT), an address management technique that is well known in the prior art. In one aspect of the present invention, the packet rewriting policies enable a layer 3 (IP) roaming capability.

In an alternate embodiment of the present invention, the augmented IP stack 203 includes support for a mobile IP Foreign Agent (FA). The mobile IP protocol is defined in RFC 2002, available at www.rfc-editor.org. In a further alternate embodiment of the present invention, the augmented IP stack includes services that detect and handle packets corresponding to various standard protocols such as the Domain Name Service (DNS) protocol, Dynamic Host Configuration Protocol (DHCP), Remote Authentication Dial-In User Service (RADIUS) protocol, and Internet Group Management Protocol (IGMP). The augmented IP stack, upon detecting a packet corresponding to one of these services, may filter the packet, forward the packet or generate a response in accordance with the policies within the managed network environment.

Referring now to FIG. 3, a preferred method of forwarding a packet to the wireless network is illustrated. Upon receipt by wireline interface 300, the packet is forwarded to augmented IP stack 301. Initially, the augmented IP stack 301 determines whether the packet should be discarded 302. If so, the packet is discarded 303 and the processing is completed. If not, the augmented protocol stack determines whether the packet must be modified 304; if so, the packet is modified in accordance with the implementation of the adapter 101. Finally, the packet is forwarded to the wireless network interface for transmission 305. At various points in this process, it may be necessary for the adapter 101 to obtain configuration information from the network control server, in which case the network coordination software in the adapter is invoked to retrieve such information. At various points in this process, the adapter may be required to report information to the network control server, in which case the network coordination software in the adapter is invoked to report the information.

Referring now to FIG. 4, a preferred method of forwarding a packet to the wireline network interface is illustrated. Upon being received by the wireless interface 400, a packet is initially forwarded to augmented IP stack 401. The augmented protocol stack determines whether the packet should be discarded (402) and, if so, the packet is discarded 403 and processing is completed. Where the packet is not to be discarded, the augmented protocol stack determines whether the packet requires modification 404. If modification is required, the packet is modified in accordance with the implementation of the adapter 101. Subsequently, the packet is forwarded to the wireline network interface for transmission 405. At various points in this process, the adapter 101 may require configuration information from the network control server, in which case the

network coordination software in the adapter is invoked to retrieve that information. At various points in this process, the adapter may be required to report information to the network control server, in which case the network coordination software in the adapter is invoked to report that information.

Referring now to FIG. 5, the adapter 101 is illustrated connected to a plurality of access points 100 via a switch 500. In an alternative embodiment of the present invention, adapter 101 provides services to a plurality of short-range wireless access points 100. In this environment, a plurality of short-range wireless access points 100 are individually coupled to switch 500. Although FIG. 5 depicts each access point 100 located on a dedicated segment connected to the switch 500, it will be apparent to those skilled in the art that a single LAN segment can contain multiple wireless access points. Adapter 101 is also attached to switch 500. In this embodiment, the adapter's wireline and wireless interfaces are preferably integrated into a single connection 503 of switch 500. In one implementation of this embodiment, the switch 500 is programmed to automatically forward all inbound packets originating from access point LAN segments 501 to the LAN segment 503 containing the adapter 101. The switch 500 is also programmed to automatically forward all packets not originating from the LAN segment 503 containing the adapter and destined to an access point LAN segment 501, to the LAN segment 503 containing the adapter 101. In this manner, the adapter 101 can receive and process all packets originating from and destined to the access points 100.

Referring now to FIG. 6, in a further alternate embodiment of the present invention, adapter 101 supports a plurality of switched LANs 102, at least some of which contain wireless access points. In FIG. 6, adapter 101 is shown connected to

three switched LANs containing wireless access points. This is merely for illustrative purposes; obviously, the number of LANs and access points can vary.

A plurality of short-range wireless access points 100 provided are coupled to switch 500. There are three access point LANs and the switch 500 of each LAN is connected to the wireless network interface of each adapter 101. The wired network interface of the adapter is connected to a pair of wired LANs 102. One or more personal computers (PCs) 600 are provided connected to each of the wired LANs. In this case, the adapter 101 receives packets sent to or from access points situated in all three switches. Moreover, the adapter is able to process packets sent to or from multiple wired networks.

Although not preferred, the access points 100 of wireless clients may be programmed to forward all wireline-destined packets to the adapter 101 by defining the destination MAC address to be that of the adapter. For example, the access points 100 can be programmed to treat the adapter 101 as a default IP gateway for network traffic. Though this accomplishes the same effect as the first implementation, it is more complex to implement and manage, and therefore less desirable.

In an alternate implementation of this embodiment, the network control server 103 can be co-located with the adapter 101 to reduce the quantity of servers necessarily installed in the network environment, and to reduce the overall system cost.

In a further alternate implementation of the present invention, the components of the network control server can be distributed to provide improved performance or failure handling.

In another implementation of the present invention, the adapter 101 can connect to access points 100 supporting different wireless networks. Furthermore, the aforementioned

different wireless networks can incorporate multiple different short-range wireless communication technologies.

Referring now to FIG. 7, the adapter 101 is illustrated connected to a access points 100 via multiple different wireless networks. These different wireless networks can employ the same network technology, in which case they have distinguished network identifiers, or they can employ different network technologies such as 802.11 and Bluetooth.

Access points 100 from different wireless networks are connected to an adapter wireless network interface. The adapter wired network interface is connected to the wired Local Area Network. It is to be understood that in alternative embodiments, the adapter can be connected to different wireless networks through a plurality of switches, as previously described with respect to FIG. 5 and FIG. 6.

While the preferred embodiments of the invention have been illustrated and described, it will be clear that the invention is not limited to these embodiments only. Numerous modifications, changes, variations, substitutions and equivalents will be apparent to those skilled in the art without departing from the spirit and scope of the invention as described in the claims.

What is Claimed is:

1. A system for providing a network adapter for one or more access points in a local area network environment, comprising:

means for connecting said one or more access points to a wired network;

means for connecting said one or more access points to a wireless network;

means for enforcing a managed network environment; and

means for communicating with a network control server.

2. A system as recited in claim 1, wherein said means for connecting to a wired network further comprises a wireline network interface.

3. A system as recited in claim 1, wherein said means for connecting to a wireless network further comprises a wireless network interface.

4. A system as recited in claim 3 wherein said wireless network interface is coupled to a wireless access point.

5. A system as recited in claim 4 wherein said wireless access point further comprises an 802.11 type access point.

6. A system as recited in claim 4 wherein said wireless access point further comprises a Bluetooth-type access point.

7. A system as claimed in claim 3 wherein said wireless network interface is coupled to a Local Area Network (LAN) port.

8. A system as recited in claim 1 wherein said means for enforcing a managed network environment further comprises an augmented IP stack.

9. A system as recited in claim 8 wherein said augmented IP stack includes a Mobile IP Foreign Agent.

10. A system as recited in claim 8 wherein said augmented IP stack detects and handles packets corresponding to a plurality of network services.

11. A system as recited in claim 1 wherein said means for communicating with a plurality of Network Control Servers further comprises a network coordination software.

12. A system as recited in claim 1 wherein said network adapter includes a plurality of wireline network interfaces.

13. A system as recited in claim 1 wherein said network adapter includes a plurality of wireless network interfaces.

14. A system as recited in claim 1 wherein said network adapter is coupled to a switch and said switch is coupled to a plurality of short-range wireless access points.

15. A system as recited in claim 14 wherein said switch is programmable to automatically forward all inbound packets from wireless access point LAN segments to a segment containing said network adapter.

16. A system as recited in claim 14 wherein said switch is programmable to automatically forward all packets not

originating from the LAN segment containing the adapter and destined to an access point segment, to the segment containing said network adapter.

17. A system as recited in claim 14 wherein the access points or the wireless clients are programmed to forward all packets to the said network adapter.

18. A system as recited in claim 1 wherein said Network Control Server is co-located with said network adapter.

19. A system as recited in claim 1 wherein said Network Control Server is co-located with a Core Server.

20. A system as recited in claim 1 wherein said Network Control Server is co-located with a Routing Coordinator.

21. A system as recited in claim 1 wherein said network adapter further comprises at least one of a stand-alone personal computer (PC) and a special purpose computing machine.

22. A system as recited in claim 1 wherein said network adapter further comprises software stored within said one or more access points.

23. A system as recited in claim 1 wherein said Network Control Sever is distributed over said network.

24. A system as recited in claim 1 wherein said network adapter is connectable to one or more access points located on a plurality of LAN segments.

25. A system as recited in claim 1 wherein said network adapter is connectable to different wireless LANs.

26. A system as recited in claim 1 wherein said network adapter is co-located with at least one of a Handoff Management Point, a Home Address Masquerader and a Foreign Address Masquerader.

27. A method for providing a network adapter for a plurality of access points in a local area network environment, comprising the steps of:

connecting said access points to a wired network;
connecting said access points to a wireless network;
enforcing a managed network environment; and
communicating with a Network Control Server.

28. A method as recited in claim 27 wherein the step of enforcing a managed network environment further comprises the steps of:

receiving packets from a wireline network;
processing said packets through an augmented IP stack;
determining whether to rewrite said packets; and
forwarding said packets to said wireless network.

29. A method as recited in claim 28, further comprising, prior to the step of forwarding said packets to said wireless network, the step of determining whether to filter said packets.

30. A method as recited in claim 27 wherein the step of enforcing a managed network environment further comprises the steps of:

receiving packets from a wireless network;
processing said packets through an augmented IP stack; and
forwarding said packets to a wireline network.

31. A method as recited in claim 30, wherein said step of processing further comprises, prior to the step of forwarding, the steps of:

determining whether to filter said packets; and
determining whether to rewrite said packets.

32. A method as recited in claim 31, further comprising the steps of:

detecting packets corresponding to a plurality of network services via said augmented IP stack; and
handling said packets.

33. A method as recited in claim 27, further comprising the step of determining an access point currently associated with a mobile client by inspecting a MAC address associated with packets transmitted by a mobile client.

Abstract

A system and a method for enabling existing short range wireless access points to participate within a coordinated networked environment through the use of adapters that extend the access points' capabilities, implement policies, and perform other operations.

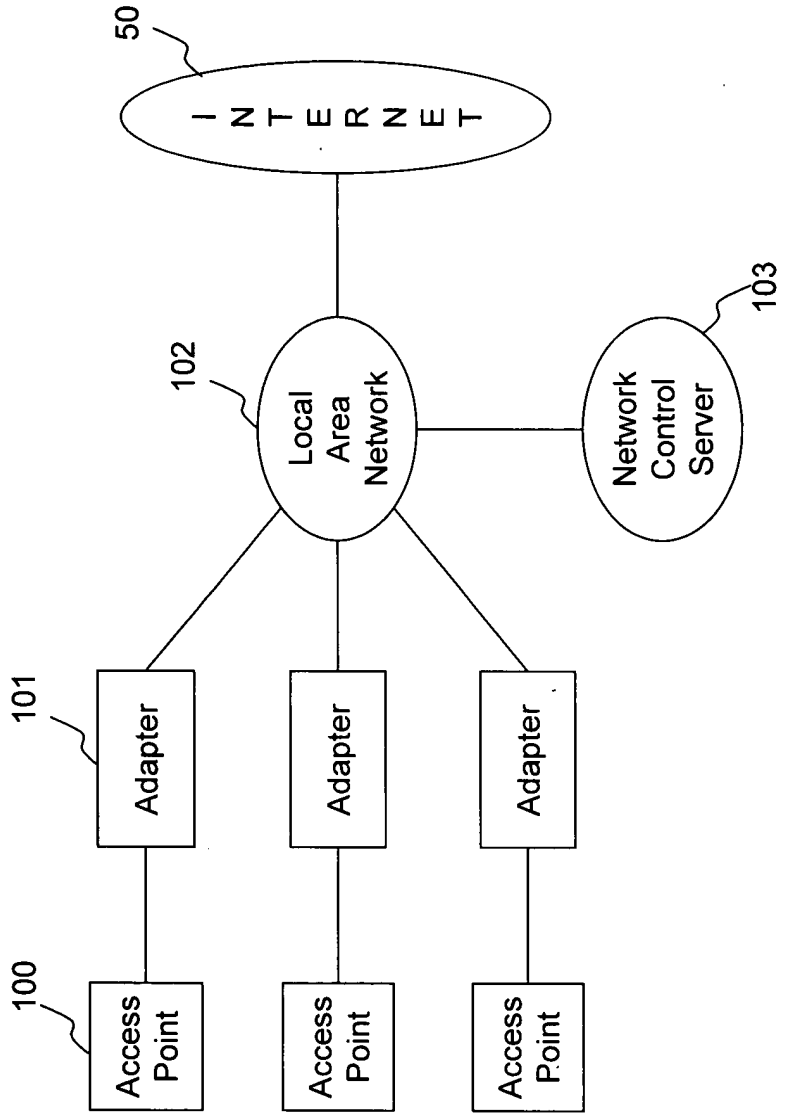
50
INTERNET
102
Local Area Network
103
Network Control Server
101
Adapter
Adapter
Adapter
100
Access Point
Access Point
Access Point

FIG. 1

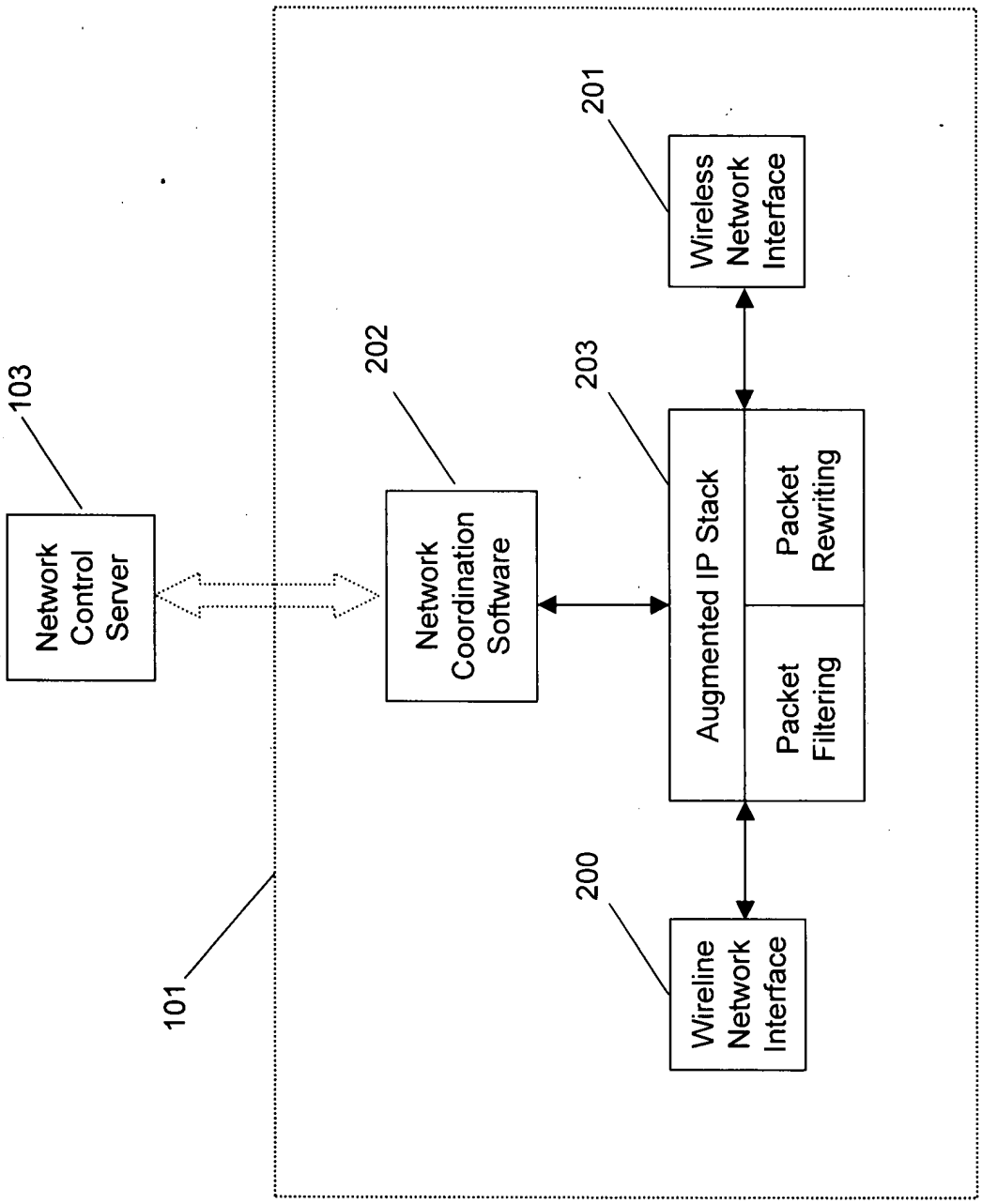
Network Control Server
103
Network Coordination Software
202
Augmented IP Stack
203
Packet Rewriting
Packet Filtering
Wireless Network Interface
201
Wireline Network Interface
200
101

FIG. 2

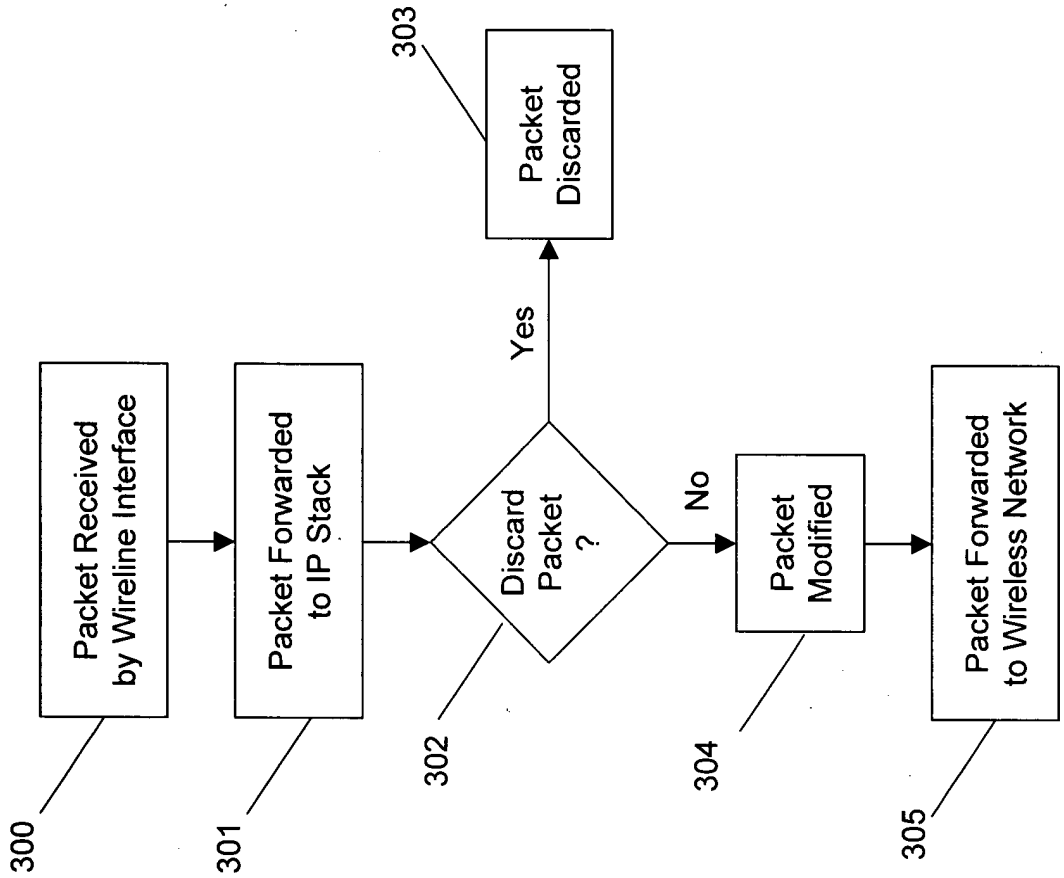
Packet Received by Wireline Interface
Packet Forwarded to IP Stack
Discard Packet ?
Yes
Packet Discarded
No
Packet Modified
Packet Forwarded to Wireless Network
300
301
302
303
304
305

FIG. 3

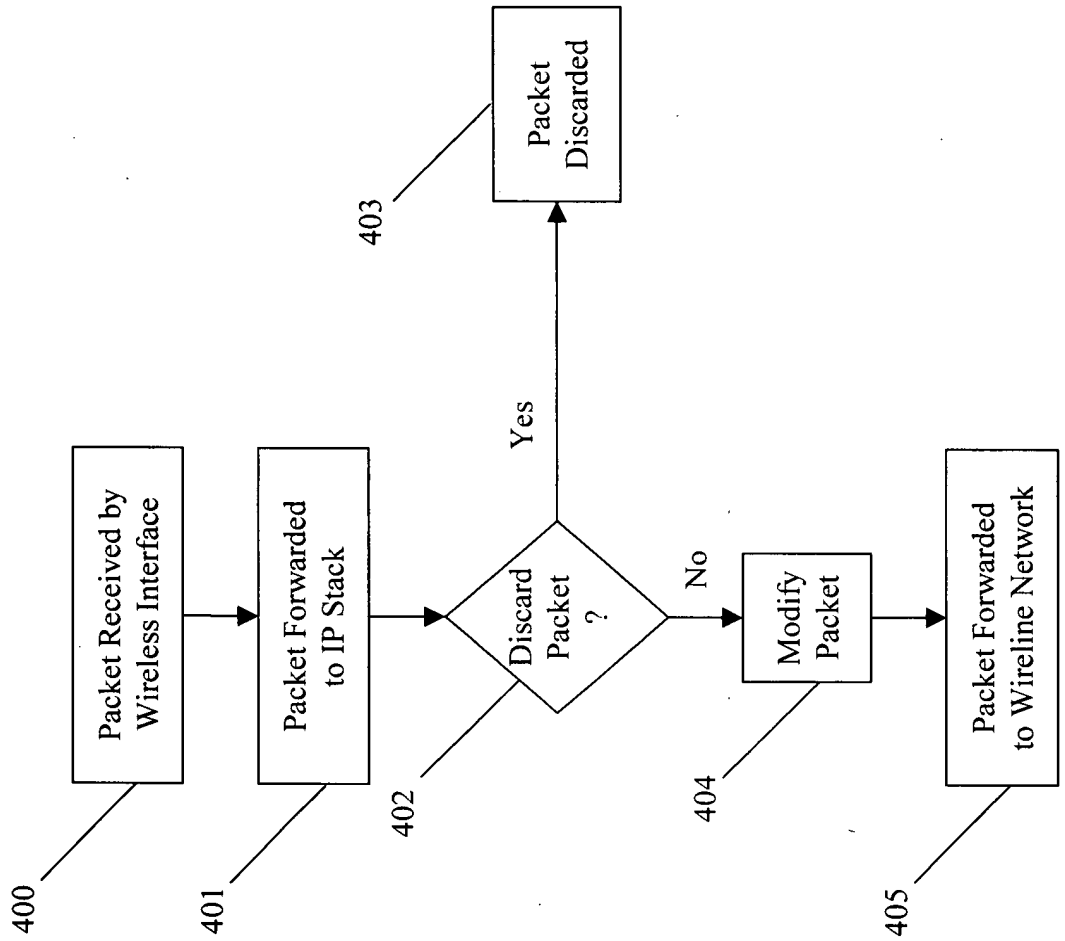
Packet Received by Wireless Interface
Packet Forwarded to IP Stack
Discard Packet ?
Yes
Packet Discarded
No
Modify Packet
Packet Forwarded to Wireline Network
400
401
402
403
404
405

FIG. 4

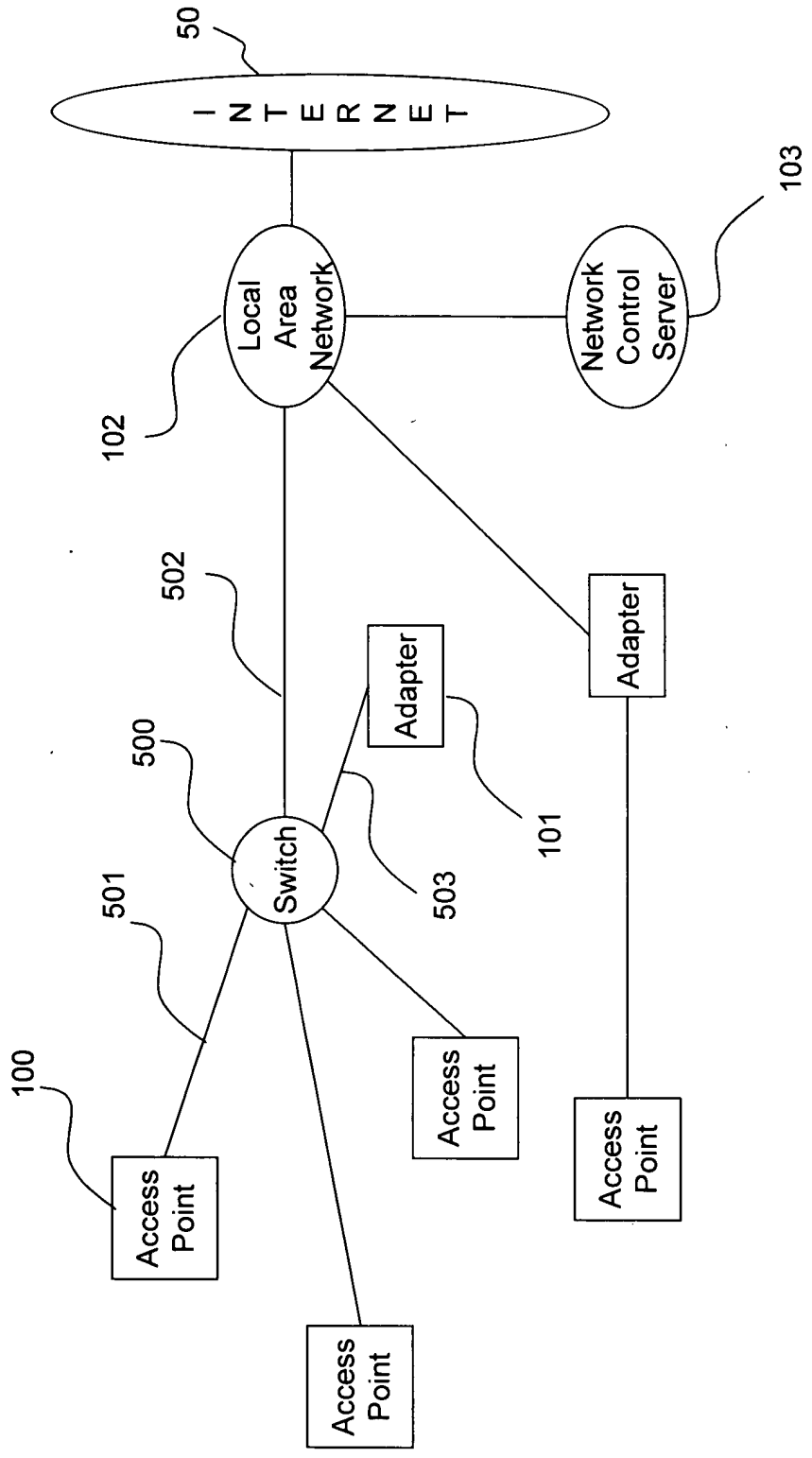
50
INTERNET
Local Area Network
102
Network Control Server
103
Adapter
101
Adapter
502
500
Switch
503
501
100
Access Point
Access Point
Access Point
Access Point

FIG. 5

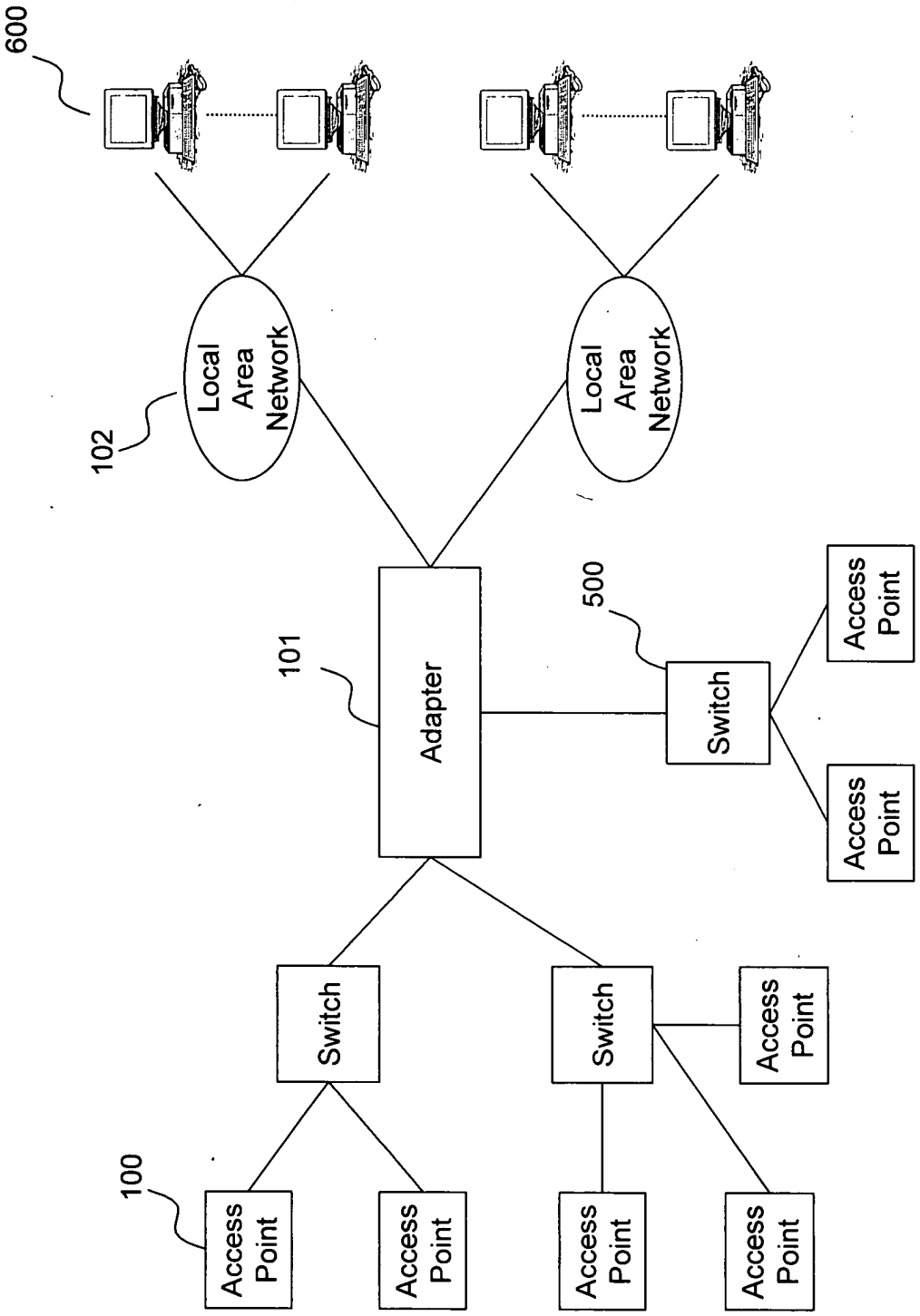
600
Local Area Network
Local Area Network
102
101
Adapter
500
Switch
Access Point
Access Point
Switch
Switch
Access Point
100
Access Point
Access Point
Access Point
Access Point

FIG. 6

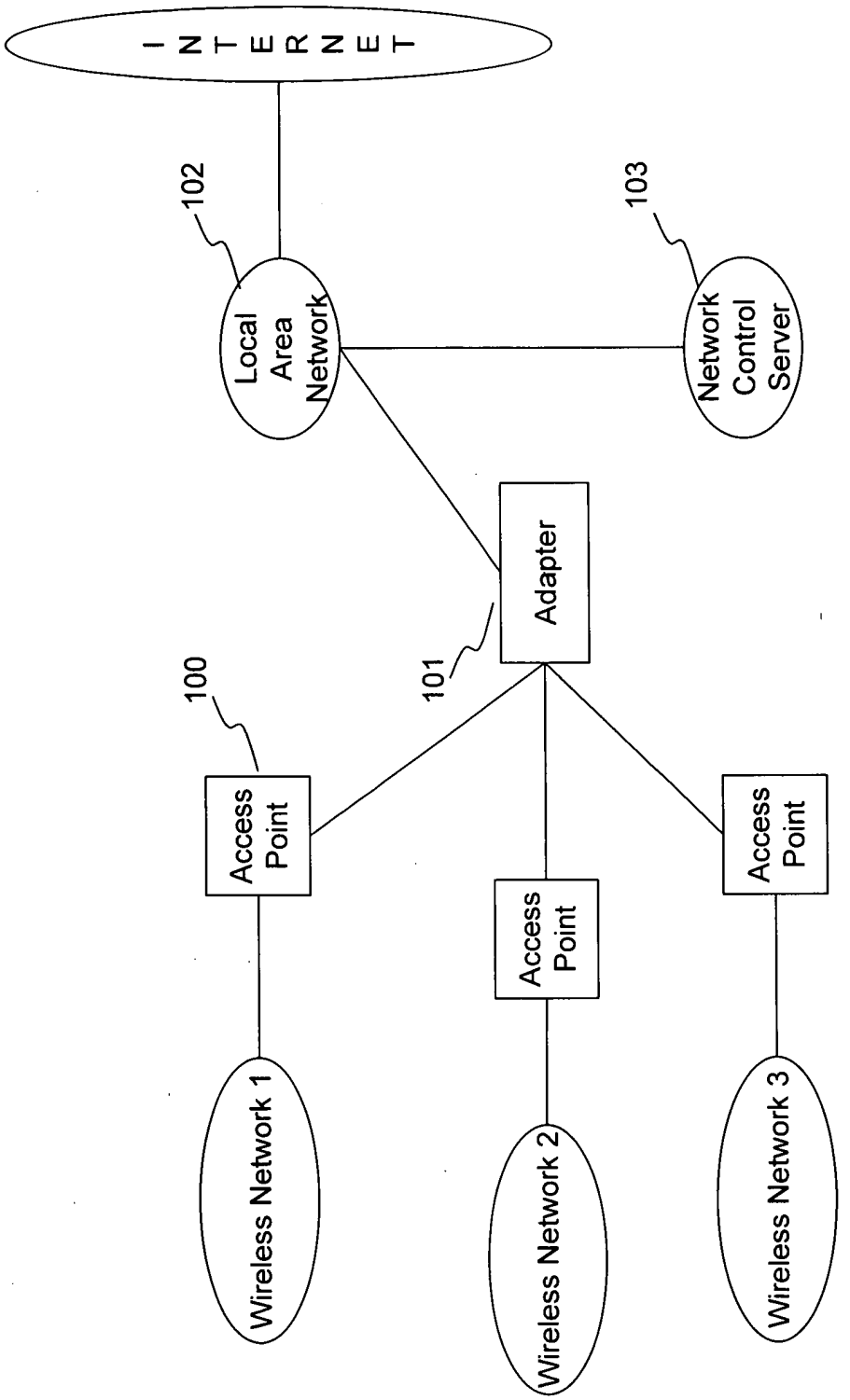
INTERNET
102
Local Area Network
103
Network Control Server
Adapter
101
100
Access Point
Access Point
Access Point
Wireless Network 1
Wireless Network 2
Wireless Network 3

FIG. 7

Docket No. 6020.0100

Applicant(s) : Singhal, et al.

For : LOCATION-AWARE SERVICE PROXIES IN A SHORT-RANGE WIRELESS ENVIRONMENT

EXPRESS MAIL CERTIFICATION

"Express Mail" mailing label number ET428884608US.

Date of Deposit May 3, 2001

I hereby certify that this transmittal letter and the other papers and fees identified in this transmittal letter as being transmitted herewith are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above and are addressed to the Hon. Commissioner for Patents, Washington, D.C. 20231.

Glenn E. Gold

Hon. Commissioner
for Patents
Washington, D.C. 20231

TRANSMITTAL LETTER FOR
ORIGINAL PATENT APPLICATION

Sir:

Transmitted herewith for filing are the [X] specification; [X] claims; [X] abstract; [X] declaration; [X] power of attorney; [X] assignment, for the above-identified patent application.

Also transmitted herewith are:

[X] 7 sheets of:

[ ] Formal drawings.

[X] Informal drawings. Formal drawings will be filed during the pendency of this application.

[ ] Certified copy(ies) of application(s)

(country)	(appln. no.)	(filed)
(country)	(appln. no.)	(filed)
(country)	(appln. no.)	(filed)

from which priority is claimed.

[X] An assignment of the invention to ReefEdge, Inc., 2 Executive Drive, Suite 600, Fort Lee, N.J., 07024.

[X] A check in the amount of $40.00 to cover the recording fee.

[ ] Please charge $40.00 to Deposit Account No._____ in payment of the recording fee. A duplicate copy of this transmittal letter is transmitted herewith.

[ ] An associate power of attorney.

The filing fee has been calculated as shown below:

FOR	NUMBER FILED		NUMBER EXTRA	RATE	FEE
BASIC FEE					$355.00
TOTAL CLAIMS	32	- 20 =	12	X $ 9 =	$108.00
INDEPENDENT CLAIMS	2	- 3 =	0	X $ 40 =	$
[ ] MULTIPLE DEPENDENT CLAIMS				+ $135 =	$
				TOTAL	$ 463.00

[X] A check in the amount of $ 463.00 in payment of the filing fee is transmitted herewith.

[ ] This application is being filed unaccompanied by a filing fee. The appropriate filing fee will be paid in response to a Notice to File Missing Parts, pursuant to 37 C.F.R. § 1.53(f).

[ ] The Commissioner is hereby authorized to charge payment of any additional filing fees required under 37 C.F.R. § 1.16, in connection with the paper(s) transmitted herewith, or credit any overpayment of same, to deposit Account No. 06-1075. A duplicate copy of this transmittal letter is transmitted herewith.

[ ] Amend the specification by inserting before the first line the sentence: -- This is a [ ] continuation-in-part, of application Serial No.: _____, filed _____ entitled _____ _____ _____ _____.

[ ] Please charge $_____ to Deposit Account No. 06-1075 in payment of the filing fee. A duplicate copy of this transmittal letter is transmitted herewith.

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